

Sphaeriidae (Bivalvia) from Peruvian Amazon floodplains, with the description of *Pisidium iquito* new species

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ABSTRACT

This article reports on the sphaeriid bivalves collected during a faunistic survey at the Pacaya-Samiria Reserve, in the Peruvian Amazon. A new species of *Pisidium* C. Pfeiffer, 1821, from floodplain habitats, is described. *Pisidium iquito* new species is defined by its large, high, not-inflated shell, with trapezoidal shell outline, beaks prominent, sub-central; the ligament externally visible and tending to be protruded, and the presence of only one branchial opening and one demibranch, are also diagnostic. The presence of *Pisidium sterkianum* Pilsbry, 1897, from small watercourses in the Peruvian Amazon is reported for the first time. *Eupera simoni* (Jousseau, 1889) is reported from the surveyed area, figured, and compared with other Peruvian and Brazilian species.

INTRODUCTION

As it is the case for large geographic areas of southern South America, knowledge of the molluscan fauna from the Amazonian floodplains is rather poor. Particularly scant is the information from the Peruvian Amazon. More extensive surveys on the molluscan fauna have been done in the Brazilian Amazon (Pain, 1960; Bonetto, 1967, 1972; Paraense, 1967, 1975). Relevant results dealing with the composition of the invertebrate assemblages in Brazilian Amazonian rainforest have also been reported by Dreher-Mansur and Valer (1992) and Volkmer-Ribeiro et al. (1998). Among Bivalves, the sphaeriid fauna of Peru and in particular of the Amazonian floodplains is virtually unknown. Previous literature records account mainly for the sphaeriids from high-altitude environments of the Central Andes (Kuiper and Hinz, 1984). To date, two *Pisidium* species, two species of *Eupera*, and three species of *Sphaerium* have been the only Sphaeriidae reported as living in Peru (Kuiper and Hinz, 1984; Ramfrez and Arenas, 2003).

In the present paper, sphaeriids collected during a faunistic survey in a small area of the Peruvian Amazon at the Pacaya-Samiria Reserve, a protected area limited by the Marañón and Ucayali rivers, are reported, and a new species of *Pisidium* is described.

MATERIALS AND METHODS

Materials for this study were obtained in September 2002, during the low-water period of the Amazon floodplains at the Pacaya-Samiria Reserve, Loreto, Peru (Figure 1). Sphaeriids were collected from stagnant water bodies, the so-called “cochas”, flowing watercourses locally called “caños” (both habitats were profusely covered by floating meadows) and from small muddy-bottom streams. The local term “cocha” designates an ancient river branch or meander that, due to high rates of sedimentation, became separated from the main course, forming ponds of variable sizes.

Sphaeriids were relaxed for study by a brief rinsing in warm water (approx. 50°C) and immediately fixed in ethanol 70°. Specimens for scanning electron microscopy were cleaned after dissection of soft parts, with a concentrated solution of sodium hypochlorite, adequately mounted and coated. Linear measurements: shell length (SL), shell height (SH), shell width (SW); shape indices and morphometric ratios: height index (HI = SH/SL), convexity index (Ci = SW/SH), and ratio hinge length (HiL): shell length (HiL/SL), were calculated according to the criteria followed by Ituarte (1996). For each calculation (N = 10), mean and standard deviation values are given.

For comparative purposes, the following type material was examined: syntypes of *Pisidium sterkianum* Pilsbry, 1897, Academy of Natural Sciences, Philadelphia (ANSP) and paratypes of *Pisidium forense* Meier-Brook, 1967, Senckenberg Museum, Frankfurt (SMF), *Eupera klappenbachi* Mansur and Veitenheimer, 1975, Museo de La Plata (MLP), and *Eupera doellojuradoi* Klappenbach, 1962, Museo Argentino de Ciencias Naturales (MACN), were used.

SYSTEMATICS

Pisidium iquito new species
(Figures 2–13)

Description: Shell thin, translucent, large (maximum observed size: 7.2 mm; mean SL of specimens examined:

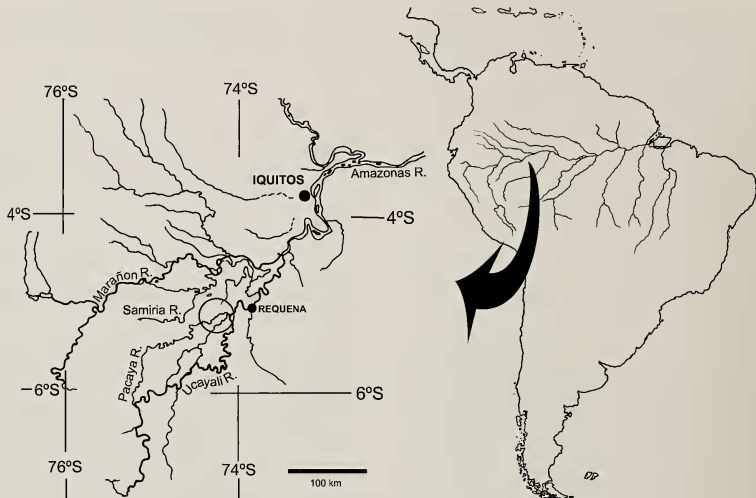


Figure 1. Location map. Encircled area indicates type locality for *Pisidium iquito* new species.

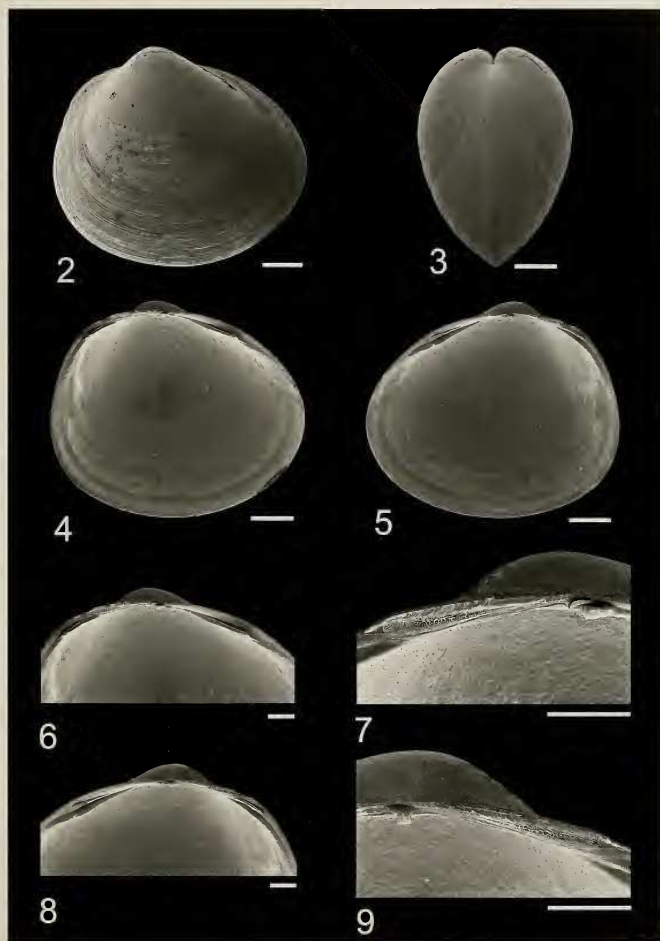
5.4 ± 1.2 , $n = 10$), somewhat high (mean HI = 82 ± 2), not convex (mean Ci = 68 ± 4), shell outline sub-quadrangular, tending to trapezoidal in medium-sized and larger specimens, anterior end produced in a short sharp curve, somewhat pointed, posterior end short, truncated, nearly straight, somewhat oblique (Figures 2, 4, 5, 11); dorsal margin gently curved, short, ventral margin uniformly and markedly curved. Beaks prominent, well raised from shell surface, wide at base, pointed at the tip, somewhat directed backward, well visible but not much projected above dorsal margin, slightly displaced backward, at about 59% of SL. Shell surface finely and irregularly striated, glossy, straw-yellowish.

Hinge plate weak, hinge line rather long (HI/SL about 57%). Hinge: Right valve (Figures 5, 8, 9): cardinal tooth (C_2) narrow and straight at anterior half, curved and enlarged in a slightly sulcated cup at posterior end. Lateral teeth slender, delicate, inner anterior lateral (AI) long, slightly curved, cusp displaced forward; outer anterior lateral tooth (AIII) very short, cusp distal; inner posterior lateral (PI) straight, cusp sub-central; outer posterior lateral (PIII) reduced in size, straight, with distal cusp. Left valve (Figures 4, 6, 7): cardinal teeth well developed, the inner (C_2) robust, blunt, projected below hinge line, slightly bent upward at tip, with base slightly oblique with respect to antero-posterior axis, the outer (C_3) a short, flat, curved lame, with distal

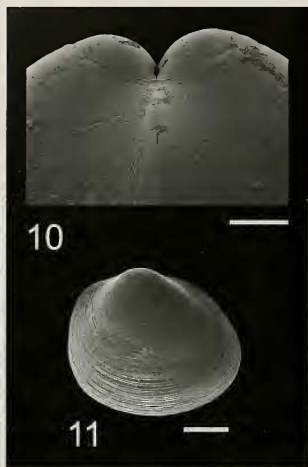
part slightly bent upward, quite oblique, overlapping C_3 at posterior half; anterior lateral tooth (AII) slender, straight, cusp well displaced distally; posterior lateral tooth (PII) relatively short, weak, slightly curved, cusp distal.

Ligament pit long and slender, lanceolate, not deep, inner margin slightly sinuous at anterior half, enlarged and uniformly concave at posterior half (Figures 7, 9). Escutcheon long, lanceolate, marked by a delicate line (Figure 10). Ligament external, long (representing about 21% of shell length), delicate, well visible from outside, moderately elevated over dorsal margin or protruded in variable degrees (Figures 7, 9, 10).

Anatomy: Only the anal mantle opening present, a pair of well developed, but not particularly strong, siphonal retractor muscles present (Figure 13). The mantle fusion anterior to anal siphon not long, representing $11 \pm 2\%$ of SL (Figure 13). Mantle edge broad. Muscle scars (up to 10 are usually clearly visible) corresponding to the inner radial mantle muscles well-marked, lying well apart from the pallial line (Figure 13), those corresponding to anal siphon retractors are coalescent with posterior adductor muscle scars, the one that would correspond to the absent branchial opening (sr_2) stronger than the remaining (Figure 13) that appear grouped in triads (Figures 4, 5). Only one demibranch, the inner, present.



Figures 2-9. *Pisidium iquito* new species. 2-3, Holotype (MLP 6859-5). 2, Right lateral view. 3, Posterior view. 4-9, Paratypes (MLP 6859-5). 4, Left valve, inner view. 5, Right valve, inner view. 6, Hinge of left valve. 7, Left valve, detail of cardinal teeth and ligament. 8, Hinge of right valve. 9, Right valve, detail of cardinal tooth and ligament. Scale bars: Figures 2-5 = 1 mm; Figures 6-9 = 500 μ m.



Figures 10–11. *Pisidium iquito* new species. Paratypes MLP 6859–5. **10.** Posterior view showing the external ligament. **11.** Lateral view of a medium sized specimen. Scale bars: Figure 10 = 1 mm; Figure 11 = 500 μm.

Brood pouches developing upward and posteriorly in each inner demibranch, with up to 24 embryos found in a specimen of 6.5 mm length. Nephridia of closed type, dorsal lobe elongate with lateral loop visible in dorsal and posterior views (Figure 12).

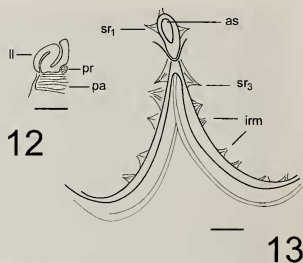
Type Locality: “Cocha” Tamara, 05°16'28" S, 74°29'55" W, Pacaya-Samiria Reserve, Department of Loreto, Peru (Figure 1).

Type Material: Holotype, MLP 6859–5; 3 paratypes: 3 MLP 6859–5, 1 MNHN unnumbered.

Other Material Examined: Unnamed small stream (05°16'12" S, 74°21'27" W) that flows into the Pacaya River, at the entrance to the Pacaya—Samiria National Reserve (Figure 1), on muddy soft bottoms, 20 specimens, MLP 6863–1–1.

Etymology: The species name refers to the Iquitos, ancient people who inhabited the Peruvian Amazon floodplains.

Remarks: *Pisidium iquito* new species is defined by its large maximum size, being the largest South American species of *Pisidium*, sub-quadrangular shell shape, prominent beaks, markedly weak hinge plate, ligament external, tending to be protruded, and by the presence of only one demibranch, the outer one, nephridia of



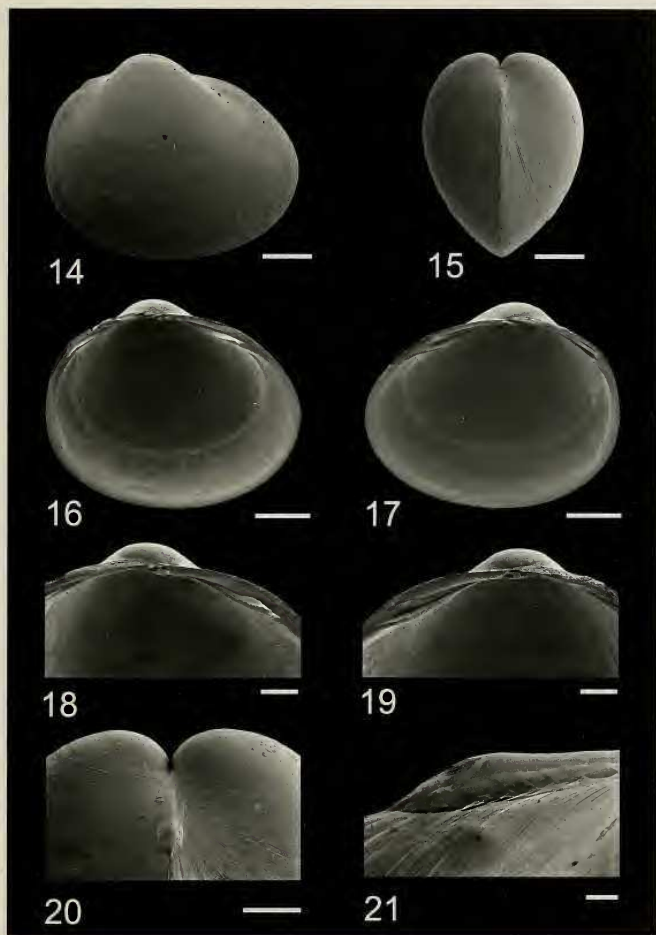
Figures 12–13. *Pisidium iquito* new species. **12.** Nephridium. **13.** Mantle muscles. (as: anal siphon; irr: inner mantle radial muscles; pa: posterior adductor muscle; pr: pedal retractor muscle; sr₁: anal siphon retractor muscle; sr₃: retractor muscle corresponding to the position of lacking branchial opening. Scale bars = 1 mm.

closed type, with dorsally visible lateral loop, and only one mantle opening, the anal. *Pisidium iquito* new species and *Pisidium sterkianum* Pilsbry, 1911, have the same the number of demibranchs, mantle openings, and type of nephridia; however, *Pisidium iquito* new species has a less convex and higher sub-quadrangular shell, with more prominent and more centrally located beaks; both species have an external ligament, although much more protruded in *P. sterkianum*. *Pisidium iquito* new species chiefly differs from *Pisidium meierbrooki* Kuiper and Hinz, 1984, from the Peruvian highlands and *Pisidium chiquitanum* Ituarte, 2001, from central Bolivian lowlands in both shell characters (being larger with no ovate shell outline) and soft anatomy (having only one demibranch and one mantle opening). *Pisidium iquito* new species resembles *Pisidium forense* Meier-Brook, 1967, from the southwestern Brazilian drainage basin, having a similar siphonal arrangement and only one pair of demibranchs; however, *Pisidium iquito* new species differs by its larger size, relatively larger height, less convexity, and beaks more displaced backwards. Baker (1930) described several sphaeriids from northern South America, among them *Pisidium bejunae* Baker, 1930, from a savanna pond in Venezuela, which is similar to *Pisidium iquito* new species in having a relatively high shell with centrally located, full, and prominent beaks; however, *P. bejunae* has smaller size, having higher and more convex, with short, ellipsoid, not trapezoidal, shell outline; the ligament also differs, not tending to be protruded as in *P. iquito* new species.

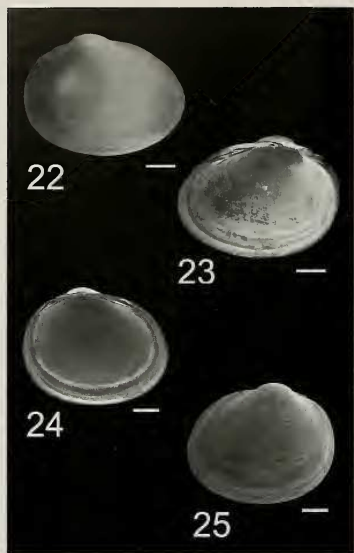
Pisidium sterkianum Pilsbry, 1897
(Figures 14–25)

Pisidium sterkianum Pilsbry, 1897: 291–292, pl. 6, figs. 1–4.

Description: Shell of medium size (maximum ob-



Figures 14–21. *Pisidium sterkianum* Pilsbry, 1897 (MLP 6863-1). 14. Right lateral view. 15. Posterior view. 16. Left valve, inner view. 17. Right valve, inner view. 18. Left valve, detail of cardinal teeth and ligament. 19. Right valve, detail of cardinal tooth and ligament. 20. Posterior view with detail of external ligament. 21. Lateral view of posterior end with detail of protruded external ligament. Scale bars: Figures 14–17 = 1 mm; Figures 18–20 = 500 μm ; Figure 21 = 100 μm .



Figures 22–25. *Pisidium sterkianum* Pilsbry, 1897. 22–23. Syntypes (ANSP 70490). 22. Right valve, outer lateral view. 23. Right valve, inner view. 24–25. MLP 5061. 24. Left valve, inner lateral view. 25. Left valve, outer lateral view. Scale bars: Figures 22–25 = 1 mm.

served SL = 5.7 mm), rather inflated (mean CI = 73 ± 2). Shell outline ovate, somewhat high (mean HI = 82 ± 3); dorsal margin slightly shorter than ventral margin, gently curved; ventral margin evenly and widely curved. Anterior end produced in a somewhat acute curve, posterior end truncated. Beaks wide at base, full, nearly central (located at about 58% of shell length), well visible above dorsal margin. Surface finely and regularly striated.

Hinge plate narrow, not solid. Hinge line long (HI/L S = 63 ± 31). Hinge: Right valve (Figures 17, 19): a minute, somewhat weak, cardinal tooth (C_2), enlarged at posterior end forming a slightly grooved cup; anterior right lateral teeth well-developed, the inner (AI) a long, broadly curved lamella, cusp low, somewhat displaced forward; the outer (AII) shorter, cusp distal, bent upward. Posterior lateral teeth straight, the inner (PI) narrow, cusp sub-central, the outer (PII) shorter with cusp distal. Left valve (Figures 16, 18): two well-developed cardinal teeth, the inner (C_2) short, bent upward at tip, the outer (C_4) slightly longer than C_2 , slender, evenly

arcuate, slightly oblique with respect to antero-posterior axis, overlapping C_2 at posterior half. Anterior (AII) and posterior (PI) lateral teeth well-developed, the anterior stronger, cusps high, triangular, displaced distally. Ligament pit slender, long, not deep. Ligament external, markedly protruded and well visible from the exterior (Figures 20, 21); ligament length about 21% of shell length.

Anatomy: Only the anal mantle opening present; only one, the inner, demibranch present, brood pouch developing from the upper part of inner wall of descending lamella, up to 8 embryos per demibranch were found. Seven weakly marked muscle scars, corresponding to inner radial mantle muscles, located slightly above the pallial line, each bundle formed by few weak muscle fibers. Nephridia of closed type, with lateral loop visible in posterior view.

Type Locality: From a creek in the "Prado" (actually corresponding to Arroyo Miguelete), Montevideo, Uruguay.

Material Examined: Unnamed small stream ($05^{\circ}16'12''$ S, $74^{\circ}21'27''$ W) that flows into the Pacaya River, at the entrance to the Pacaya-Samiria National Reserve (Figure 1), on muddy soft bottoms; 27 syntypes ANSP 70490; > 50 specimens, Arroyo Miguelete (a small watercourse flowing into the Río de La Plata), Ensenada Buenos Aires, Argentina, MLP 5061.

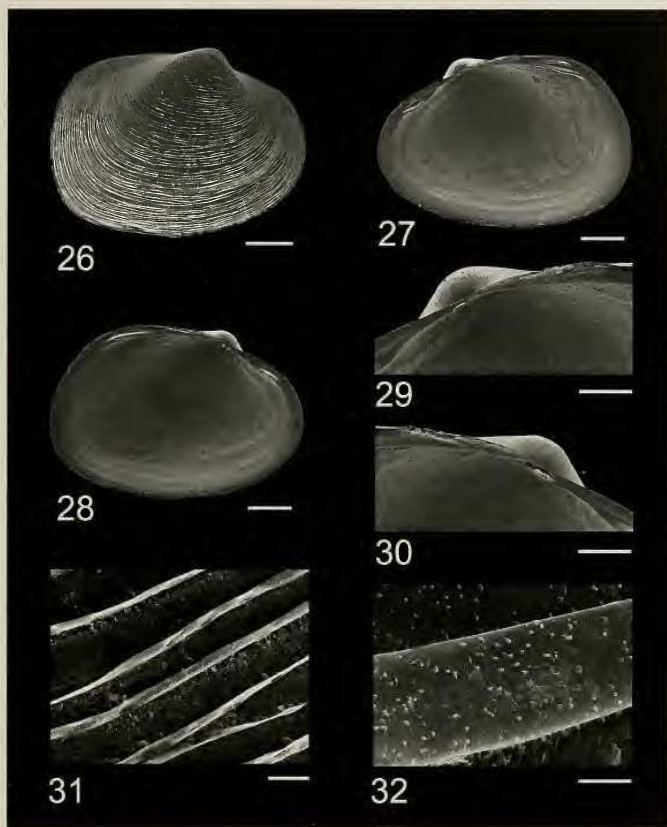
Remarks: Diagnostic characters of *Pisidium sterkianum* are: shell rather solid, medium-sized, inflated, beaks wide, sub-central; ovate shell outline, expanded forward, ligament external and protruding, only exhalant mantle opening and only inner demibranch, present; nephridia of closed type, with lateral loop visible from dorsal view.

When compared with the syntypes of *Pisidium sterkianum* (ANSP 70490) (Figures 22, 23) and specimens from the Río de La Plata, Argentina (MLP 5061) (Figures 24, 25), the general shell shape of Amazonian specimens is somewhat higher, the shell outline is less oval with posterior end consistently higher, markedly truncated, and beaks are more outstanding from shell surface.

Eupera simoni (Jousseaume, 1859)
(Figures 26–32)

Limosina simoni Jousseaume, 1859: 217, pl. 9, figs. 22, 23
Eupera simoni Klappenbach, 1967:110; Dreher Mansur and Valer, 1992: 94; Dreher-Mansur and Meier-Brook, 2000: 5.

Description: Shell medium to large (maximum observed SL = 8 mm), relatively low (mean HI = 71 ± 2), not inflated (mean CI = 70 ± 5), shell outline moderately oval, posterior end truncate, slightly curved, oblique in larger specimens, anterior end evenly rounded, not pointing (Figures 26–28). Dorsal margin slightly and evenly arcuate, ventral margin widely curved. Beaks triangular, pointed, well marked-off from shell surface, but



Figures 26–32. *Eupera simoni* (Jousseaume, 1889). 26. MLP 6859–6. Right valve, outer lateral view. 27–30. MLP 6864–1. 27. Right valve, inner lateral view. 28. Left valve, inner lateral view. 29. Right valve, detail of cardinal tooth and ligament. 30. Left valve, detail of cardinal tooth and ligament. 31. Periostracum folds. 32. Detail of periostracum folds and papillae. Scale bars: Figures 26–28 = 1 mm; Figures 29, 30 = 500 μ m; Figure 31 = 25 μ m; Figure 32 = 5 μ m.

not prominent, somewhat directed forward; located at about 33 % of shell length (Figures 26–28).

Hinge plate weak, extremely narrow below beaks, hinge line relatively long (HiL/SL about 60%). Hinge: Right valve (Figures 27, 29): cardinal tooth (C_3) weak, a straight, narrow blade, very close to ventral margin of

hinge plate; anterior lateral teeth short, the inner (AI) robust, cusp sub-central, the outer (AIII) quite reduced in size; posterior lateral teeth (PI and PIII) delicate, slender, almost straight. Left valve (Figures 28, 30): cardinal tooth (C_3) minute, not very high, anterior (AII) and posterior (PII) lateral teeth relatively low, slightly

curve, cusps sub-central in AII, nearly distal in PII. Inner shell surface with spots of dark pigment sparsely distributed in small groups, two larger pigmented areas above and below scar of posterior adductor muscle, usually present. Periostacrum thin, forming commarginal folds, periostacrum surface entirely covered by very small papillae, up to 0.5 μm long, distributed without a definite pattern (Figures 26, 31, 32).

Anatomy: The general anatomy fits into the generic diagnosis. Worth mentioning is a somewhat marked development of the posterior foot retractor muscle, whose insertion point is well marked just over the scar corresponding to the posterior adductor muscle. Up to 18 embryos were found within each maternal demibranch.

Type Locality: Laguna de Espino, Caracas, Venezuela.

Material Examined: Pacaya-Samiria Reserve (Figure 1): Cocha Tamara, 05°16'28" S, 74°29'55" W (MLP 6859-6); Cocha Yarina, 05°24'42" S, 74°30'23" W (MLP 6865-1), attached to roots of *Eichornia* sp.; Pacaya River, 5°16'55" S, 74°25'45" W (MLP 6886-1), on roots of floating meadows; Caño Yarina, 05°21'28" S, 74°30'29" W (MLP 6864-1).

Remarks: *Eupera simoni*, a common species in the Peruvian Amazon, is easily identified by the somewhat shortened shell outline due to the posterior truncated margin, beaks small, pointed, relatively low but well discernible from shell surface, and periostacrum raised in well-defined commarginal folds. *Eupera primei* Klappenbach, 1967, described from water courses close to the Ucayali River, Peru, not far from Pacaya-Samiria Reserve, differs from *E. primei* in having a higher shell, with shell outline tending to be circular, dorsal margin strikingly curved, and very low periostacral folds. *Eupera klappenbachi* Mansur and Veitenheimer, 1975, a species common in western Brazilian drainages, is similar to *E. simoni*, consistently differing in being higher and more convex, and having more prominent and pointed beaks; *Eupera platensis* Doello Jurado, 1921, from the Río de La Plata has a more solid shell, with more centrally located beaks, stronger cardinal teeth and robust laterals. *Eupera simoni* is quite different from *Eupera guaraniana* Ituarte, 1994, from the Uruguay River, a large species with a striking trapezoidal shell outline, and also differs from *Eupera elliptica* Ituarte and Mansur, 1993, from the Iguazú River, Northern Argentina, a species characterized by its strikingly elliptic shell outline. *Eupera guaraniana* and *E. elliptica* also differ from *E. simoni* in having two types of periostacral papillae, the larger ordered in radial rows.

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LITERATURE CITED

- Baker, B. 1930. The Mollusca collected by the University of Michigan-Williamson expedition in Venezuela. Occasional Papers of the Museum of Zoology 210: 1-90.
- Bonetto, A. A. 1967. La superfamilia Unionacea en la cuenca Amazónica. Atas do Simpósio sobre a Biotá Amazônica 3 (Limnologia): 63-82.
- Bonetto, A. A. 1972. A new species of Monocondylaeinae from the Amazon basin, and some considerations on this subfamily in the hydrographic systems of South America. *Amazoniana* 3: 224-230.
- Dreher-Mansur, M. C. and R. M. Valer. 1992. Molluscos bivalves do rio Uraricoera e rio Branco, Roraima, Brasil. *Amazoniana* 12: 85-100.
- Dreher-Mansur, M. C. and C. Meier-Brook. 2000. Morphology of *Eupera* Bourguignat 1854, and *Byssanodonta* Orbiguy 1846 with contributions to the phylogenetic systematics of Sphaeriidae and Corbiculidae. *Archiv für Molluskenkunde* 128: 1-59.
- Ituarte, C. F. 1996. Argentine species of *Pisidium* Pfeiffer, 1821, and *Musculium* Link, 1807 (Bivalvia: Sphaeriidae). *The Veliger* 39: 189-203.
- Jousseume, F. 1859. Voyage de M. Eugène Simon au Venezuela. Mollusques. Mémoires de la Société zoologique de France 2: 232-259, pl. 239.
- Klappenbach, M. A. 1967. *Eupera primei* sp. n. de la región del río Ucayali, Perú (Mollusca, Pelecypoda). Atas do Simpósio sobre a Biotá Amazônica (Limnologia) 3: 109-115.
- Kuiper, J. C. J. and W. Hinz. 1984. Zur Fauna der Kleimmuscheln in den Anden. *Archiv für Molluskenkunde* 114 [1983]: 137-156.
- Pain, T. 1960. *Pomacea* (Ampullariidae) of the Amazon River System. *The Journal of Conchology* 24: 421-432.
- Paraense, W. L. 1967. Molluscos planorbídeos da Amazonia. Atas do Simpósio sobre a Biotá Amazônica 3 (Limnologia): 187-194.
- Paraense, W. L. 1975. Estado atual da sistemática dos planorbídeos brasileiros (Mollusca, Gastropoda). *Arquivos do Museu Nacional, Rio de Janeiro* 55: 105-128.
- Pilsbry, H. A. 1897. New species of mollusks from Uruguay. Proceedings of the Academy of Natural Sciences of Philadelphia, May 1897: 290-298, 2 pl.
- Ramírez, R. C. and J. Arenas. 2003. Molluscos del Perú. *Revista de Biología Tropical* suppl. 3: 225-292.
- Volkmer-Ribeiro, C. M., M. C. Dreher Mansur, P. A. S. Mera and S. M. Ross. 1998. Biological indicators in the aquatic habitats of the Ilha de Maracá. In: Milliken, W. and J. A. Ratter (eds.) *Maracá: The Biodiversity and Environment of an Amazonian rainforest*. John Wiley & Sons, London.